TOXICS USE REDUCTION

PLANNING GUIDANCE

Published in accordance with MGL 21I
and
310 CMR 50.00

Massachusetts
Department
of
ENVIRONMENTAL
PROTECTION

Developed in collaboration with:
Office of Technical Assistance for Toxics Use Reduction
Toxics Use Reduction Institute
Executive Office of Environmental Affairs

Revised
December 2005

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I. Introduction

The Toxics Use Reduction Act (TURA, MGL c. 21I) and its regulations at 310 CMR 50.00, establish toxics use reduction as a central component in the Commonwealth's efforts to protect public health and the environment and to promote the competitive advantage of Massachusetts businesses through efficient materials use and management. TURA requires certain facilities that manufacture, process, or otherwise use listed toxic materials in their operations above specific thresholds to file annual reports detailing their management of toxics, and to undergo a planning process to identify opportunities for toxics use reduction. The outcome of the planning process is a toxics use reduction plan (TUR plan).

This guidance document includes minor updates to the TUR Planning Guidance that was last published by MassDEP in 2002. Its purpose is to provide guidance on the requirements of the planning process and to describe the required elements of a TUR plan (see also 310 CMR 50.40). This guidance document will prove helpful to new Toxics Use Reduction Planners and new TURA filers. In addition to this guidance document, every two years MassDEP publishes a shorter TUR Plan Update Guidance that includes planning year-specific forms and guidance that can be used for the current planning year.

Please note that this guidance is substantially unchanged from the 2002 guidance, except for minor edits to ensure consistency with revised TURA regulations that were promulgated in October 2004

A. What is the purpose of planning?

TUR planning is designed to bring about a new management approach to environmental protection. TUR planning is based on the premise that minimizing or eliminating the use of toxic chemicals or reducing the generation of toxic byproduct (waste) will result in less pollution requiring treatment or control and will reduce potential exposure of workers and releases to the environment.

TURA requires companies to develop a planning process and to complete a toxics use reduction (TUR) plan. The planning process is designed to help facilities identify opportunities for toxics use reduction that make economic sense for them.

B. What is "Toxics Use Reduction"?

Toxics use reduction (TUR) involves changes in the ways chemicals are manufactured, processed, or otherwise used, or byproducts are generated, in the production process *per unit of product produced*. Toxics use reduction can be accomplished through a variety of means: input substitution, product reformulation, production unit modification, production unit modernization, improved operations and maintenance, and in-process recycling or reuse. The law does not require companies to use less of a substance. Reducing production levels would not be considered TUR, and neither the law nor the regulations require Massachusetts industries to take such a step.

TUR, as defined by the law, can be accomplished in two main ways:

1) Reducing or eliminating the use of a chemical per unit of product produced,

2) Decreasing the generation of byproduct per unit of product produced (thereby

increasing the efficiency of the production process by reducing the amount of the substance "wasted" during production).

One way to reduce or eliminate the use of a chemical per unit of product is through input substitution. However, for many facilities in Massachusetts input substitution is not feasible. For example, stamped metal parts containing a TUR listed metal may be the product a company sells so the company could not eliminate or reduce the metal and remain in business. Or the toxic chemical may be a significant part of a company's product or the production process for which there is no practical substitute.

The other TUR approach is for companies to change their production processes so that the chemical is used more efficiently so that less is wasted during production and there is less byproduct generated per unit of product produced. For example, painting methods can be changed to reduce overspray and increase transfer efficiency so that less of the paint ends up as hazardous waste, or cutting procedures can be changed so that less material ends up as scrap. Improved efficiency reduces the quantity of a toxic chemical used per unit of product -- if less is wasted in production, less will be used per product produced.

C. What does TUR Planning Involve, and What does it Commit My Facility To?

The planning process involves:

- Examining how toxic chemicals are manufactured, processed, or otherwise used, and byproducts are generated
- Identifying TUR techniques
- Evaluating the technical feasibility of potential TUR techniques
- Evaluating the costs and savings of potential TUR techniques

The process provides a means for toxics users to identify any changes in their production processes that will both reduce toxic chemical use or waste AND save the facility money.

A completed TUR plan must specify which toxics use reduction techniques the facility plans to implement. Companies are not required to implement any techniques; however, past experience indicates that when companies have done TUR plans, they often discover TUR techniques they want to implement because doing so is in their best interest.

If a company decides to implement a TUR technique, the TUR plan must contain an implementation schedule developed in good faith. However, facilities are not required to abide by the implementation schedule. Companies may find, with time, that markets change or they may learn new information about the TUR technique. If a facility decides to alter or abandon an implementation schedule, the regulations require that an explanation for the decision must be included in the next plan update (plan updates are required every two years).

D. General Guidelines for Developing Plans

The planning process is designed to complement a facility's existing planning processes as much as possible. The TURA regulations are flexible, leaving companies free to use whatever process and format works best for them. Paperwork and procedural requirements are limited to those required by the statute. Companies are encouraged to use available data when appropriate. In fact, many companies routinely compile much of the information needed to do an adequate plan in the normal course of their business.

There are three standards to which companies must adhere in preparing a TUR plan:

- Good engineering practices
- Standard accounting practices
- Completing the plan in good faith

Decisions made during toxics use reduction planning and implementation are like other business decisions companies make. Each of these standards addresses, to some extent, how much information the company needs to gather and evaluate to make informed decisions about toxics use reduction options. The rule of thumb is that the analysis has to be good enough to make informed business decisions. For some decisions, virtually no analysis is appropriate or required. Other choices require a great deal of in depth study, monitoring, and testing.

There are no specific engineering procedures or cost evaluation techniques for meeting these standards. This guidance will explain each of the principles by example in the latter part of this document.

When calculations need to be done for a plan, the calculations and any assumptions used to do the calculations must be included in the plan. Supporting data and other documents used as the basis for the calculations may be referenced in the plan. The plan must specify the location of all referenced documentation and supporting data.

Analyses and calculations that are developed for a plan may be presented in the plan in a variety of ways. The analyses can be included in the plan in their original form, whether handwritten, a formal consultant's report, a computer printout, etc. There is NO need to reformat or retype the work done. As long as the information is legible, it can be included as is. Also, companies may cross reference duplicate information in the plan. Information and calculations must be retained at the facility for at least five years, after the date that the plan is due.

E. The Guidance Document Format

This guidance explains and interprets the TUR plan regulations (310 CMR 50.40). Specifically, it explains the required steps in the planning process and the required elements in the written plan. It includes "model" plan components, both simple and complex examples, and blank tables that facilities may use in their plans. These examples illustrate a range of approaches a facility might use. Other approaches to planning and formats for presenting plan information also may be appropriate.

The regulations contain two broad sets of requirements -- requirements for the planning process and for the contents of the TUR plan. The planning process is made up of the analyses and decisions that facilities must make in order to develop a complete and certifiable plan. The content requirements describe what must be included in the plan.

This guidance does not describe all of the approaches that can be taken to develop a TUR plan. For tips on TUR planning, you should also refer to <u>A Practical Guide to Toxics Use Reduction</u>, available from the Office of Technical Assistance (call 617-626-1060 to obtain a copy).

II. GENERAL PLAN GUIDANCE

A. Applicability of the Planning Process (310 CMR 50.41)

Facilities that are large quantity toxics users (LQTUs) are required to file annual toxics use reports and develop biennial TUR plans. A facility is an LQTU only if it meets the following three criteria:

- employed the equivalent of at least 10 full-time employees (FTEs);
- conducted any of the business activities described by Standard Industrial Classification (SIC) codes 10 - 14, 20 - 39, 40, 44 - 51, 72, 73, 75 and 76; and
- manufactured, processed, or otherwise used a TURA-regulated chemical in excess of a reporting threshold.

The term "manufacture" includes coincidental production of a TURA-listed substance (e.g., as a byproduct or impurity) as a result of the manufacture, processing, otherwise use, treatment, disposals or other waste management of other chemical substances. For example, neutralization of wastewater containing nitric acid can result in the coincidental manufacture of a nitrate compound (solution), reportable as a member of the nitrate compounds category. As another example, combustion of sulfur containing fuels can result in the coincidental manufacture of sulfuric acid. In addition, combustion of some fuels (e.g., #6 fuel oil) which contain polycyclic aromatic compounds (PACs) involve both the otherwise use of PACs and the coincidental manufacture of PACs.

Each facility required to file a toxics use report must develop a TUR plan for each chemical included in their report.

B. Plan and Plan Update Due Dates (310 CMR 50.41) and Exceptions to the Plan Due Dates/Planning Requirements

MassDEP requires plans and plan updates to be completed only in even-numbered calendar years. For example, facilities that filed a toxics use report by July 1, 2005 (for use in 2004) and are required to file a toxics use report by July 1, 2006 (for use in 2005), must complete a TUR plan or plan update by July 1, 2006. If a facility first reports a chemical by July 1, 2006 (for use in 2005), the first TUR plan for that chemical would need to be completed by July 1, 2008. A good faith effort to identify and evaluate toxics use reduction (TUR) opportunities through the TUR planning process will benefit your facility by identifying opportunities to eliminate waste, cut costs, and achieve a cleaner, healthier workplace and environment.

Under the following circumstances plans or plan updates are not required: when a chemical has been eliminated, when a chemical is below a reporting threshold, or when a facility if scheduled to close. Please refer to the Certification Statement/Exceptions to Plan Requirements on page 6.

C. Waste Treatment Chemicals

Plan requirements differ for waste treatment chemicals. Only the facility-wide elements of the plan apply to waste treatment chemicals. Thus, if a company used chemicals only for waste treatment, the plan would consist of a certification statement, management policy, employee participation section, scope of the plan, and the plan summary (including the certification statement and facility-wide projections for use and byproduct). When a company uses a chemical in a production unit and in waste treatment, and the total of the two uses exceeds the chemical's reporting threshold, all elements of the plan must be done for the chemical used in the production unit, regardless of the quantity, as is the case with any other covered toxic.

D. Where the Completed Plan is Kept/Recordkeeping Requirements [310 CMR 50.42(7)]

Plans must be kept at the facility. However, all the referenced supporting information need not be kept together or even with the plan itself. The TUR plan must state where at the facility supporting materials can be found. The plans and supporting documentation must be kept for at least five years after the plan completion date.

The TUR plan as well as any supporting documentation must be made readily available for review if requested by a MassDEP inspector. Only MassDEP has the authority to review the TUR plan.

Because the entire plan is confidential, companies may not designate portions of the plans confidential and therefore exclude those portions from MassDEP inspector review. All inspectors must be allowed to review the plans in their entirety after receiving special training in reviewing confidential reports.

Plan summaries must be submitted to MassDEP. Portions of the plan summaries may be claimed confidential. A sanitized version (i.e., one that does not contain confidential information) of the plan summary will be available for public review. (See MassDEP's confidentiality regulations at 310 CMR 3.00.)

CERTIFICATION STATEMENT/EXCEPTIONS TO PLAN REQUIREMENTS

I certify under penalty of law that to the best of my knowledge and belief the following is true (choose 1, 2, or 3):

1) **Eliminate Chemical**

_____________________ has eliminated the use of_________________
(facility name) (chemical name)

by taking the following steps (describe):
____.

2) **Reduce Use Below Threshold**

(a) _____________________ has reduced the use of ___________________
(facility name) (chemical name)

by taking the following steps (describe):
____.

(b) Based on our estimates, use of the TURA-reportable chemical described in 2(a) will not exceed a reporting threshold in _________.
(year)

3) **Expect Facility Closure**

(a) On or before _____________, ________________________
(date) (facility name)

is scheduled to close its facility located at the following location:
____.

(b) On or before the date specified in 3(a), the facility plans to cease the use of the following chemicals:

____

____

4) I am aware that there are penalties for submitting false information, including possible fines.

____ ___________________
Signature of Senior Management Official Date

____
Print name of Senior Management Official

III. PLAN PROCESS AND CONTENTS

It is important to note that some portions of a TUR plan cover the entire facility, while others cover specific production unit/chemical combinations. Certification statements, management policy, employee participation and the plan scope apply to the entire facility. The remainder of the planning -- process characterization; options identification, evaluation and implementation planning -- is done at the production unit level. These sections must be completed for each covered toxic in each production unit in which the chemical is used (i.e., each chemical production unit/chemical combination reported on the annual Form S). The plan summary, which is the document that must be submitted to MassDEP, has both facility-wide and production unit/chemical-specific information.

The plan sections are discussed below in the order in which they are likely to be completed.

A. Management Policy [310 CMR 50.43(1)]

The facility must describe its policies regarding toxics use reduction in a statement of management policy. Strong management commitment is central to successful development and implementation of toxics use reduction programs. Since a toxics use reduction program encompasses many facets of the facility operations, such as process engineering, environmental management, financial analysis, research and development, it is essential that support and coordination for toxics use reduction occur at the management level.

Management policies may be in a variety of formats including:

- Narrative statement;
- Concise bullet points;
- Logo with a statement of philosophy.

The policy must include, at a minimum, the following:

- Description of the ways in which the company encourages toxics use reduction; and
- Description of any policy applicable to the company that encourages toxics use reduction.

The policy also may include descriptions of the company's policies or decision rules that are designed to promote TUR within a facility. These policies could be in the areas of:

- Research and development;
- Financial investments or capital investments;
- Hiring promotions, or bonuses, or other incentives for company employees; and
- Any other policy applicable to the company that encourages toxics use reduction.

The management policy in example 1 meets the two minimum requirements: it describes the ways in which the company encourages TUR and the policies affecting TUR. This management policy is a broad statement of company philosophy.

Example 2 meets the two minimum requirements and it elaborates on the basic requirements by discussing toxics use reduction in relation to research and development, financial decisions, and training for new employees.

These two examples illustrate two types of management policies. **Facility 2** chose to state specific numeric goals for reducing air emissions and waste entering the environment. Whereas, **Facility 1** discussed its policies in a more philosophical manner. In addition to these approaches, a management policy could include a company commitment to evaluate a particular production process for TUR opportunities or a phase-out of an older process line in favor of a modernized version.

It would not be acceptable to have a management statement dealing only with pollution control or waste minimization. The management statement must describe the company's policy toward reducing either the use of toxic chemicals or the generation of toxic byproducts.

Example 1

Management Policy

We, the management of **Facility 1**, aim to produce the highest-quality products possible while minimizing our use of toxic materials. In this effort, our highest priority will be the proactive pursuit of cost-effective process changes which reduce or eliminate the use and/or generation of toxics at the point of production. Where toxics cannot be eliminated at the source, reuse and recycling of materials will be explored and implemented wherever possible. These objectives will be incorporated into the design of new production processes, the redesign of existing processes, and the construction of new facilities. We encourage all employees to forward their suggestions for helping to reduce our reliance upon toxic substances.

Example 2

Management Policy

Corporate Policy Statement

We will work to protect the environment at each location. To support our Environmental Protection Policy Statement, we will:

- Continue to work to develop manufacturing processes designed to eliminate or minimize pollution.
- Establish and maintain discharge standards designed to protect the environment at all locations where **Facility 2** has operating control.
- Establish controlled or monitored disposition of all waste and byproducts.
- Cooperate with government agencies to develop appropriate environmental rules and regulations based on sound scientific standards.

Example 2 (continued)

In example 2, the facility has a broad environmental policy goal of minimizing impacts on the environment by increasing raw material use efficiencies, improving manufacturing processes, and reducing wastes entering the environment. Towards reaching this goal, using 1987 as a base year, **Facility 2** has pledged to reduce all Section 313 air emissions by 90% by the end of 1992 and all EPCRA listed waste entering the environment or being transferred off-site by 70% by the end of 1995.

The attainment of these short and long-term goals is every employee's responsibility with the Plant Manger being ultimately responsible. To assist the Plant Manager and the facility, a Toxics Use Management (TUM) Team has been formed to oversee the development, assessment and implementation of the plant's TUM policy and techniques. The TUM team is headed by the plant's Environmental Protection Superintendent and consisted of 15 other members representing; accounting (2), manufacturing (2), engineering (2), environmental engineering (3), research and development (2), marketing (2), and sales (2).

While no formal TUM employee incentive program has existed, the TUM team has developed a program to supplement its New Employee Orientation and Professional Orientation Programs training. Additionally, all members of the plant and departmental TUM teams have received a special orientation and training on TUM planning. Supplemental to these programs, there is an informal program in place where employees are given personal recognition for outstanding reduction efforts. These forms of recognition could include corporate certificates, awards, and monetary bonuses.

The facility's corporate policy and its emission reduction goals has been given preference over normal capital investment criteria. This means that the company would implement projects which would help achieve the reduction goal despite being uneconomical. Typically, the facility has expected a XX% return on money invested on new projects and would only proceed with projects that met these criteria. However, with the new reduction policies in place, projects which reduced chemical emissions would be implemented if they were required to ensure that the company has met its goals.

The toxics program has affected research and development by requiring consideration of alternatives which eliminate or reduce environmental impacts in the development of new products or processes. This has typically influenced research and development into evaluating water-based materials versus organic based materials, and low hazard materials versus higher hazard materials. While this would reduce the use of certain chemicals, the most significant reductions to be expected would be reduced wastes in the production line.

All managers and technical professionals are to be held accountable for their area's environmental compliance record as well as their efforts towards achieving their reduction goal. Byproduct and emissions reduction are an important part of an employee's job description and will be evaluated for their contributions at the time of their annual review.

B. Scope of Plan (310 CMR 50.43(2))

The scope of plan section describes the production units and chemicals included in the plan and the types of TUR techniques evaluated. It serves as an introduction to the plan so the reader knows what the plan covers.

The scope of plan must include a description of each production unit, including production unit number, process, product, unit of product, and the chemicals and CAS numbers from each Form S associated with the production unit (this description may be the same as that used in the Form S's). In addition, it must include the process for identifying TUR options and a summary of all the toxics use reduction techniques that were considered appropriate and underwent a comprehensive technical and economic evaluation (see section F below).

The plan scope also may include any other information about the planning process and the company's environmental activities the facility chooses to include. The company may choose to submit this additional information to MassDEP as a part of the plan summary. The scope of plan may be used as an opportunity to tell the public all of the environmentally beneficial things that the company is doing. This can include those actions that meet the definition of toxics use reduction, as well as other environmentally beneficial actions such as recycling, water or energy conservation, or pollution prevention of waste streams that are not listed TURA chemicals.

For example, an environmentally beneficial action such as non-integral recycling onsite often results in very high byproduct numbers. The scope can be used to explain the reasons for the high byproduct numbers and why the facility is choosing to do non-integral recycling rather than doing toxics use reduction as defined by the law. It is important to remember, however, that while the scope MAY be used in this way, doing so is OPTIONAL.

Below are two sample scopes of plans. Example 3 is in a narrative format. Example 4 is a less elaborate version of the same scope of plan. Both sample scopes of plans are acceptable.

The scope of plan cannot be completed until TUR options have been identified and evaluated. Though it serves as an introduction to the plan, it is likely that companies will finish the scope of plan once the rest of the plan has been completed.

Examples 3 and 4 were developed for one production unit and two chemicals. However, if a company has more than one production unit/chemical combination, it must clearly show which chemicals are associated with each production unit.

Example 3

Scope of Plan

Facility 3, located at Main Street, Boston is a manufacturer of soft urethane foam products. The foam produced by **Facility 3** is primarily used in the manufacture of mattresses and seat cushions. Scrap foam generated by the plant is ground and pressed into carpet pads. **Facility 3** employs 250 people at its 42,000 square foot manufacturing, warehouse and headquarters facility.

Since the use, storage and byproduct generation of the facility's reportable chemicals is associated with a single production step, **Facility 3** considers the entire facility to be one production unit

Example 3 (Continued)

(Production Unit #1 on the facility's Form S). Foam is produced at the plant by the controlled expansion of the reaction caused by mixing a urethane polymer with a reactant containing toluene diisocyanate (CAS # 26471-62-5) (TDI). The softness of the foam is controlled by the simultaneous addition of a low boiling point blowing agent. **Facility 3** utilizes methylene chloride (CAS # 75-09-2) as its auxiliary blowing agent. Processes associated with this production unit include: foam production, curing and cutting. Scrap foam from cutting operations is recycled and resold whenever possible.

During the foam reaction TDI is completely reacted with the urethane resin. Presently, the methylene chloride is vented to the atmosphere under a MassDEP air emissions permit. Due to a number of reformulation changes, process modifications, the use of additives and housekeeping controls, methylene chloride use, on a unit of product basis, has dropped by over 66% during the past three years.

In developing and evaluating additional potential toxics use reduction strategies, **Facility 3** concentrated on approaches which would greatly reduce or eliminate methylene chloride from the process. Options for reducing TDI use and byproduct were limited since the chemical is an integral part of the reaction which produces the foam and industry-wide research on altering the basic reaction of foam generation has yet to find any acceptable substitute for TDI.

In developing reduction strategies for consideration, **Facility 3** reviewed trade publications and EPA databases, attended trade association meetings on toxics reduction, hired an outside technical consultant to examine current operating practices, and conducted brainstorming sessions among all production supervisors and line personnel. This review produced over 35 potential reduction options for the two chemicals used on-site. Some of these options included additional minor process adjustments, the use of new additives, more stringent chemical handling procedures, alternative blowing agents, and newly developed production technologies.

Based on a screening review of the technical feasibility, potential toxics reduction and cost savings, most of the options were eliminated for the reasons stated later on in this Plan. Three options dealing with chemical handling procedures and production scheduling were obviously favorable and already have been implemented. Of the options which involve substantial investment or process modifications, three options for methylene chloride and one for TDI were deemed appropriate and therefore underwent a more complete economic and technical evaluation. For methylene chloride, **Facility 3** considered: 1) the purchase of a processing technology which does not require a blowing agent; 2) substituting a water and acid mixture as the blowing agent; and 3) an air emission control system which would allow the blowing agent to be recycled. The option fully examined for TDI was installing a system that would allow TDI emissions to be vented back to the delivery truck.

Using a present value analysis, **Facility 3** determined that the option involving the purchase of a new production line which utilizes state-of-the-art foam application technology, would provide a 20% return on investment, while simultaneously reducing methylene chloride use by 100%. Free from the restrictions of its air emissions permit, **Facility 3** anticipates a substantial growth in production over the next three years. The option involving substitution of a water and acid mixture as the blowing agent, and an air emissions control system which would allow the blowing agent to be recycled, were rejected because the present value analysis showed a lower return on investment

Example 3 (Continued)

than the state-of-the-art foam application technology.

During the time that it will take to get the new system operating, **Facility 3** implemented 3 of the chemical handling options identified during the screening process for a 15% reduction from current use levels. Because the TDI venting changes only would result in a one-pound reduction of TDI byproduct at a significant cost this option was not selected for implementation.

Example 4

Scope of Plan

Facility 3

Production Unit
#1 - Foam production using curing and cutting.
The product is soft urethane foam products.

Chemicals
Methylene Chloride (75-09-2)
Toluene Diisocyanate (26471-62-5)

Process for Identifying TUR Options
Review of trade publications
Review of EPA databases
Trade meetings on TUR
Hired outside consultant
Brainstorming sessions – production supervisors and line personnel

TUR Options to be Implemented
New process technology not requiring Methylene Chloride
Revised chemical handling and production scheduling (immediately implemented)

TUR Options Requiring Further Evaluation
Substituting a water and acid mixture as the blowing agent
Air emission control system that allows recycling of blowing agent

TUR Options that Were Rejected
TDI Venting Changes

C. Employee Participation [310 CMR 50.42(5)]

As part of the planning process, facilities must notify all employees to solicit ideas on increasing the efficiency of chemical use and reducing waste. Facility personnel in various fields such as engineering, environmental compliance, marketing, finance, purchasing, sales, production, management, quality control, legal, health and safety, materials control, and research and development, represent a wide range of expertise and all may have TUR ideas to contribute.

To comply with the planning requirement, the company is required to do the following <u>at least six</u>

months before the plan due date (i.e., by January 1st of each planning year):

- Notify all of its employees of the requirements of the plan or plan update
- Identify the toxic chemicals and production units included in the plan or plan update
- Make available the requirements and criteria for the plan; and
- Solicit comments and suggestions from employees on toxics use reduction options.

The plan need only describe the steps it took to notify employees. It is not necessary that the employee notice be in writing. If the company notified the employees through a written notice, then the plan should include the written notice and a description of how and when it was distributed (see Example 5 for an example written employee notice).

Example 5

Employee Notification

The notice shown below was posted on the employee bulletin board from October 1, 2005 - January 1, 2006. It also was included with each employee's paycheck the week of October 14th. Pursuant to MGL 21I, The Massachusetts Toxics Use Reduction Act, Facility 5 will be preparing a toxics use reduction plan. The purpose of the plan is to describe how, where, and the amount of toxic chemicals used at our plant and to identify, evaluate and select methods for reducing toxics use and toxic waste.

The plan will be developed in accordance with Massachusetts regulations 310 CMR 50.40. Copies of these regulations may be obtained from the shop foreman and the personnel director. Facility 5 uses methyl ethyl ketone (MEK) in the inks used on presses two and three, and to clean the presses between runs.

The toxics use reduction plan must include:

- A management policy about toxics use reduction,
- A process flow diagram for the use of MEK in each press, including the quantity of MEK used and the amount that becomes waste MEK
- Options for reducing the quantity of MEK used in production or wasted during production, including input substitution, process modernization, process changes, product changes, improved housekeeping, integral recycling, reuse of the waste
- An evaluation of the above options based on technical and economic feasibility
- A decision about which options, if any, the company will implement, and an implementation schedule for each option.

The plan must be completed by July 1, 2006, and approved by a Toxics Use Reduction Planner. The plan remains on-site but a summary must be submitted to MassDEP. We are seeking employee input on ways in which the company could reduce the quantity of MEK used or wasted in production. Please offer any ideas you may have to either your foreman or myself. You may do so verbally, or preferably, in writing. There will be a box in the employee cafeteria for suggestions.

Plant Manager, 10/1/2005

D. Process Characterization (310 CMR 50.44)

A process characterization must be done for each production unit/chemical combination. The process characterization includes:

- Purpose of the chemical in the process,
- Unit of product,
- Process flow diagram,
- Materials accounting.

The process characterization will serve as the foundation for the rest of the TUR planning process. This data will help pinpoint where in the process the chemicals are used and where byproduct originates. It also identifies opportunities for toxics use reduction. By clearly delineating the quantity of the chemicals that are used and the byproduct generated during the use, the company will have important information for quantifying the total cost of using the toxic.

Unit of Purpose/Product of the Chemical

The plan must include a statement which explains the purpose the toxic chemical serves in the production process.

The unit of product for the production unit/chemical combination must be stated in the plan. This metric for measuring the amount of product produced has already been identified in the annual toxics use reports (i.e., Form S). In the course of developing TUR plans, facilities may decide to change their unit of product. This is acceptable, provided that the same unit of product is used on the current and future toxics use reports, and that the Byproduct Reduction Index (BRI) is adjusted in accordance with the procedures outlined in the annual reporting guidance. A correction, or adjustment to the base year ratio of byproduct per unit of product also must be made in order to reflect the unit of product change for future BRI determinations.

Process Flow Diagram

A process flow diagram is required for each production unit and chemical combination. It must be a visual representation of the movement of the covered toxic through the processes within a production unit. The locations on the process flow diagram where chemicals enter and exit the process as products or byproducts, and the ultimate fate of the byproducts, whether treatment, recycling, transfer or direct release to the environment, must be noted. The production unit number indicated on the Form S must be included on the diagram.

While the points where the covered toxics are lost from the production unit as byproduct must be identified, they do not need to be quantified in this phase of the planning process. However, the company will need to quantify the releases from particular points in the process in the course of completing the required technical and economic evaluation of TUR options.

A process flow diagram is required because these diagrams are the best manner in which to understand how chemicals are used "in process" and to identify opportunities for reductions in either toxics use or byproduct generation.

If several covered toxics are used in the same production unit, the process flow diagram (PFD) need not be repeated as long as the places each of the covered toxics enter and exit the production unit are clearly shown on one diagram.

Example 6 shows the general locations on a PFD where the chemicals enter and exit the production units as input, byproduct, emissions and product, and the materials accounting for each chemical (materials accounting requirements are discussed below). Example 7 shows a PFD, but the quantities of chemicals are indicated elsewhere in the plan. Either type of PFD is acceptable.

Materials Accounting

A detailed materials accounting describes total inputs and outputs of the covered toxics in the production unit for the year on which the plan is based. Input data includes the quantity of chemical used in the production unit. Output data describes the losses as byproduct, the quantities treated on-site, and the quantities released or transferred off-site to the air, water, or publicly owned treatment works, and as solid and hazardous wastes.

Materials accounting is required so that planners gain an understanding of where and how the substances are used, where there are opportunities for reducing losses, and to help quantify the costs of using the chemicals.

A materials accounting must be done for each production unit/chemical combination. The materials accounting includes the total amount and the amount per unit of product of each covered toxic that is:

- Manufactured, processed or otherwise used,
- Generated as byproduct,
- Released to the environment or transferred off-site (i.e., emissions).

Table 1 on page 25 is an optional table that may be used in the plan to show the total amount of the chemicals used, generated as byproduct, and released or transferred as emissions.

Byproducts and emissions are further quantified to determine the amount:

- Treated on-site,
- Treated off-site,
- Recycled on-site,
- Recycled off-site,
- Disposed of on-site,
- Disposed of off-site,
- Released to the environment.

The plan must quantify the amount of the chemical that went to each of the environmental media. Environmental media are defined as air, water (surface water, groundwater, and wastewater treatment facilities), and transfers off-site to solid waste disposal, hazardous waste disposal, and recycling. Table 2 on page 26 is an optional form that may help companies present the data for byproducts and emissions.

Byproducts are all non-products (or wastes) generated during production released directly to the environment or sent to on-site or off-site recycling, treatment or disposal. Emissions are only those substances that are released directly to the environment, disposed of on-site, or transferred off-site. Any materials destroyed in on-site treatment or non-integrally recycled on-site would be counted as

byproduct, but would not be counted as emissions.
In other words, a byproduct is any non-product output of a listed chemical prior to handling, transfer, treatment, or release to the environment. All process outputs from a recycling operation also are counted as byproduct. An emission is any byproduct that leaves the facility boundary directly or after treatment or recycling.

When doing the materials accounting, companies need to consider the level of precision they desire. A rule of thumb is "the number has to be good enough to make informed business decisions." Measurements, estimations or engineering calculations are all acceptable approaches for obtaining byproduct and emissions amounts. Methods of quantification will probably differ from company to company, and may differ within a company for each chemical or production unit. In addition, facilities may choose to refine their calculations later in the planning process when they are trying to decide whether or not to implement a particular TUR technique.

All of the following methods fall within the criteria of "standard engineering practices" and can be used for determining byproducts and emissions, provided they are accurate enough to meet the rule for making good business decisions. Other methods may also be appropriate.

- EPA published or facility determined emissions factors
- Continuous monitoring
- Extrapolations from periodic monitoring
- Design calculations (e.g., estimating yield for a chemical manufacturing operation)
- Mass balance calculations such as the assumption that the amount otherwise used equals byproduct (e.g., no direct measurement of emissions)
- Engineering calculations using physical and chemical property data found on material safety data sheets or other sources
- Laboratory results (e.g., solvent content of coated product)

The calculations and assumptions used in the materials accounting must be included in the plan. The source of the data used (e.g., consultant reports, monitoring data) in the calculations may be referenced. MassDEP does not expect the calculations to be typed.

Facilities already will have completed much of the materials accounting needed for planning in the course of preparing their annual Form S and Form R. For example, in order to quantify the byproduct reduction index for each covered toxic in each production unit, the company will have had to determine the quantity of the toxic generated as byproduct in the production unit. Likewise, facilities will have had to quantify total emissions of each chemical from each production unit to calculate the emissions reduction index. Finally, in order to complete the Form Rs, facilities may have determined the emissions and releases to each environmental media from each production unit.

To the extent that the calculations and reference documents used to support the Form S and Form R calculations meet the planning requirements, they can be used in the plan. However, the information required for the plan is more specific than that for the Form S and Form R. Therefore, the documentation for the Form S and Form R may not be sufficient.

Example 6

Process Flow Diagram and Materials Accounting

Facility 6
Production Unit: 1, Paper Filter and Sheet Production
Chemical: Sulfuric Acid

PRODUCTION UNIT 1

Description of Unit

Facility 6 produces specialty paper products for a variety of applications. Sulfuric acid is used in the paper manufacturing process. There are two paper production lines, one for each paper line, which make up this production unit. All sources of wastewater for each production line are combined and are sent to the on-site wastewater treatment plant. This includes any wastewater or sulfuric acid spills which are collected in trenches. Discharges to Bubbling River are continuously monitored for pH.

Chemical Specific Information

Sulfuric acid is used in paper manufacturing in order to maintain the pH at the level that achieves optimum fiber dispersion. Sulfuric acid is added directly to the pulper and additional sulfuric acid is added to the white water tower in order to maintain the desired pH.

The unit of product for this production unit is total pounds of paper for the two production lines. For the previous year the amount of product was 6,000,000 pounds of paper.

The total amount of sulfuric acid (CAS NO 7664-93-9) "otherwise used" annually, based upon production records, is 100,000 pounds. On a per unit of product basis this results in:

100,000 lbs H_2SO_4/ 6,000,000 lbs of paper = 0.0167 lbs $H_2 SO_4$/lbs of paper

The sources of byproducts and emissions at each step in the process are shown below and shown in Figure 6-1.

Byproducts

Source	Amount	Estimation Method	Destination
Wastewater	99,000 lbs	Estimated 1% of H_2S0_4	Treated On-Site Wastewater Treatment residual in product. The remainder goes to wastewater treatment

The total amount of byproduct is 99,000 lbs. On a per unit of product basis this results in:
99,000 lbs H_2SO_4 / 6,000,000 lbs of paper = 0.0165 lbs H_2SO_4/lbs of paper

Example 6 (continued)

Emissions

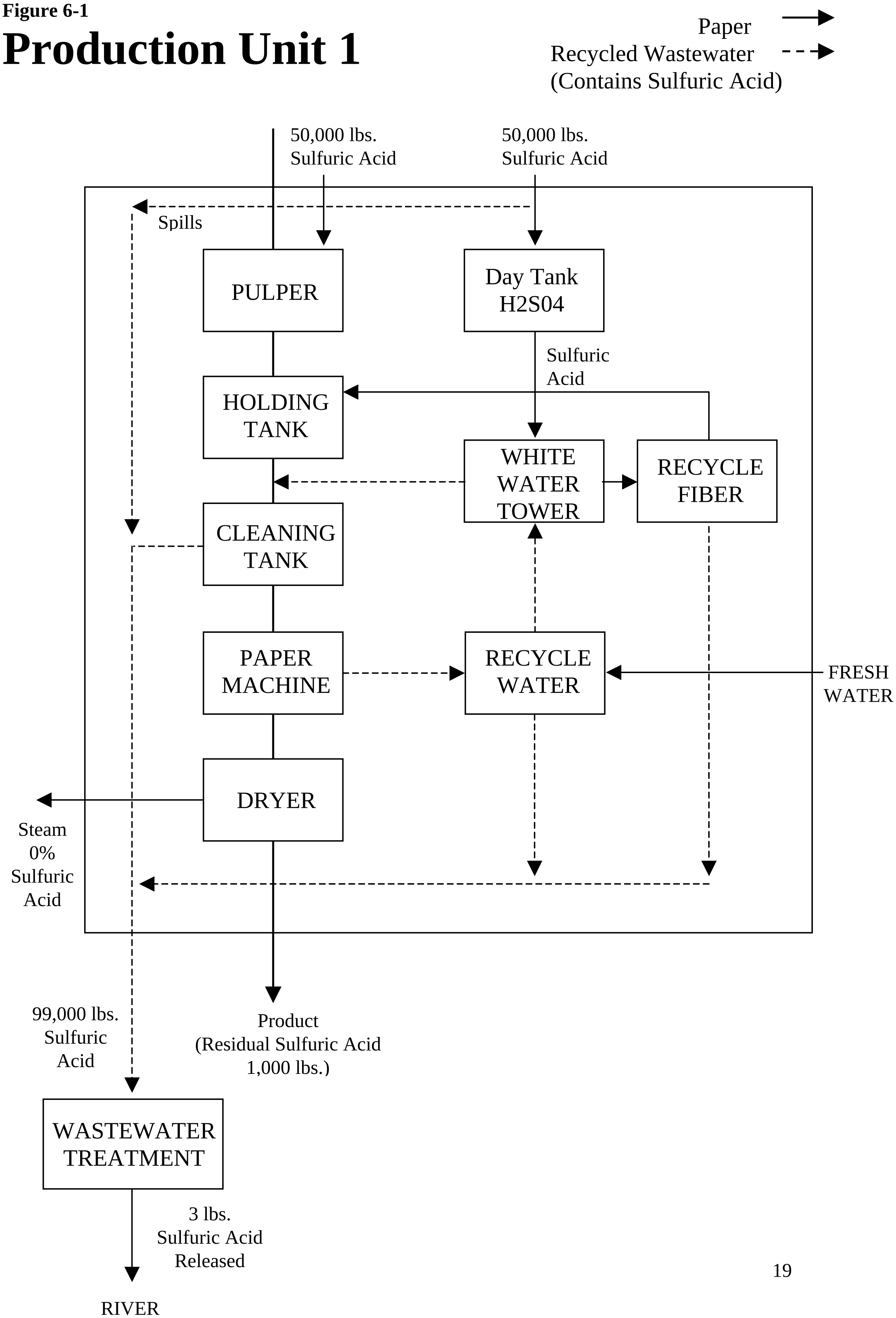
Media	Amount	Estimation Method	Destination
Water	3 lbs	Calculated from discharge pH measurements or determined from pH versus pounds of H_2SO_4 charts	Released to Bubbling River
Air	0 lbs		
Off-site transfers	0 lbs		
On-site disposal	0 lbs		

The total amount of H_2SO_4 emissions is 3 lbs. On a per unit of product basis this results in:

3 lbs H_2SO_4 / 6,000,000 lbs of paper = 5×10^{-7} lbs H_2SO_4/lbs of paper

Figure 6-1

Production Unit 1



Example 7

Process Flow Diagram and Materials Accounting

Facility: **Facility 7**
Process: Adhesive Lamination
Production Unit: #1 Laminating Product A
Chemical: Trichloroethylene (79-01-6)

Process Description

Twin Set (registered) Adhesive Laminators are used to apply trichloroethylene (TCE) solvent-based two-part adhesive with 44% adhesive solids to one side of a face fabric. The face fabric is then brought into contact with a lining fabric to form the laminated two-ply fabric. The laminated fabric is rolled up within the laminator enclosure and then set aside to cure. The two-part adhesive reacts and sets up the cure. The cured laminated fabric is then trimmed and packaged.

The majority of the applied TCE is released within the enclosed laminator and is captured with a carbon adsorption system with a recovery efficiency of 98%. There are emissions from the adsorber and the cooling tower that chills the process water. There are emissions from the transfer of adhesive to buckets and from spoiled adhesive not applied to the fabrics. There are fugitive emissions from the laminator, the curing step and from trimming and packaging. Any edge trim and defects do not get shipped and there also are fugitives from them.

The majority of the information used in this assessment was gathered from the facility's emission study conducted by a consultant for completion of a BACT analysis and Air Permit Application. All emissions measurements referenced in this plan were taken as part of this study. This document, including all test results, is maintained in Facility 7's environmental files.

Description of Production Unit

The adhesive lamination process is divided into a number of production units, one for each product type. Each product type has different characteristics in regards to the amount of adhesive applied per linear yard, and percentage of applied TCE emitted at each emission point.

The unit of product for this production unit is M (1,000) linear yards of product type A. For the year used in developing this plan the amount of product produced was 875 M yards of Product A.

The total amount of trichloroethylene (CAS NO 79-01-6) "otherwise used" annually as based upon production records is as follows:

5,482 gal adhesive x 11.366 lbs/gal x 56% TCE = 34,893 lbs plus pure 349 lbs non-integrally recycled TCE added to maintain viscosity **Total = 35,242 lbs TCE**

On a per unit of product basis this results in:

35,242 lbs TCE / 875 M yards = 40.3 lbs TCE/M yds

Example 7 (continued)

The sources of byproducts and emissions at each step in the process are quantified below and shown in Figure 7-1.

BYPRODUCTS

Source	Amount	Estimation Method	Destination
Mixing			
Fugitive Emissions	73 lbs	Measured	Released
Spillage (assumed to have evaporated)	352 lbs	Estimation Factor of 1%	Released
Laminating			
Fugitive Emissions	105 lbs	Measured	Released
Hazardous Waste	1,430 lbs	Manifests, Production Records	Treated Off-Site
Curing			
Fugitive Emissions	479 lbs	Measured	Released
Trimming & Packaging			
Fugitive Emissions	1,974 lbs	Measured	Released
Carbon Adsorption Unit			
Point Source Emission	493 lbs	Monitored	Released
Cooling Tower Emissions	158 lbs	Process Knowledge	Released
Tote Loading Emissions	17 lbs	Emission Factors	Released
Emissions from Scrap	282 lbs	Estimated from typical production information	Released
Non-Integral Recycling	349 lbs	Measured	Within Process

The total amount of byproduct is 5,712 lbs. On a per unit of product basis this results in: 5,712 lbs TCE / 875 M yards = 6.5 lbs TCE/M yd

The difference in the 35,242 lbs use figure and 5,712 byproduct figure is 29,530 lbs. 4,884 lbs of the 29,530 lbs is shipped in the product. The remaining amount, 24,646 lbs, is vented to the carbon adsorption unit, recovered and reused in the manufacture of the adhesive. The recovered TCE is loaded into Tote containers and is shipped to the adhesives manufacturer for credit against future adhesive purchases. It is therefore considered to be byproduct as product. 349 lbs that is recovered is used for mixer viscosity control as non-integral recycled byproduct.

Example 7 (continued)

EMISSIONS

Media	Amount	Estimation Method	Destination
AIR			
Mixing			
Fugitive Emissions	73 lbs	Measured	Released
Spillage (Assumed to have Evaporated)	352 lbs	Estimation Factor of 1%	Released
Laminating			
Fugitive Emissions	105 lbs	Measured	Released
Curing			
Fugitive Emissions	479 lbs	Measured	Released
Trimming & Packaging			
Fugitive Emissions	1,974 lbs	Measured	Released
Emissions from Scrap	282 lbs	Estimated from Typical Production Information	Released
Carbon Adsorption Unit			
Point Source Emission	493 lbs	Monitored	Released
Cooling Tower Emissions	158 lbs	Process Knowledge	Released
Tote Loading Emissions	17 lbs	Emission Factors	Released
TOTAL AIR	3,933 lbs		
WATER	0 lbs		
OFF-SITE TRANSFERS			
Laminating			
Hazardous Waste	1,430 lbs	Manifests, Production Records	Treated Off-Site
ON-SITE DISPOSAL	0 lbs		

The total amount of emissions is 5,363 lbs. On a per unit of product basis this results in:

5,363 lbs TCE / 875 M yards = 6.1 lbs TCE/M yd

Figure 7-1

Production Unit 001

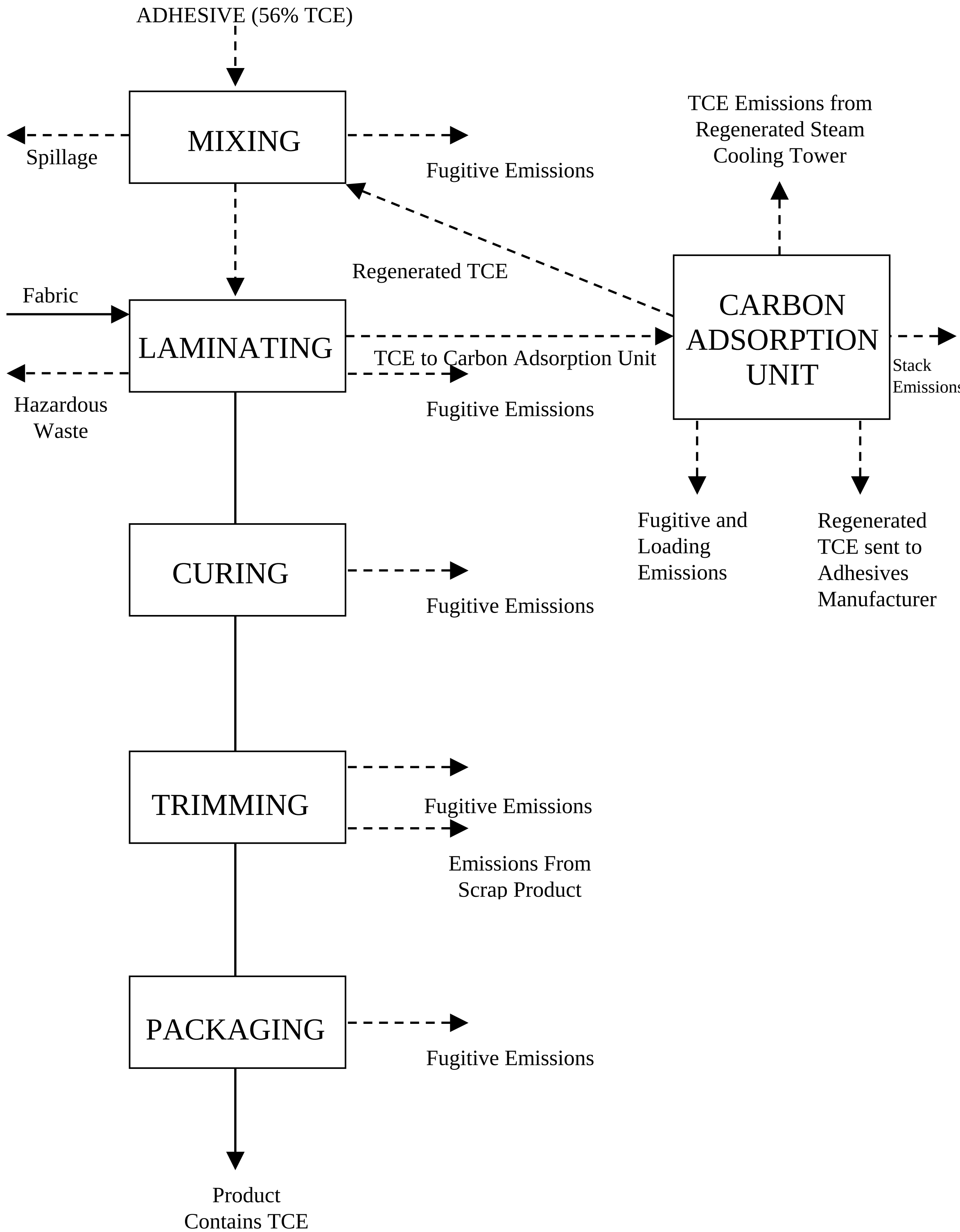


Table 1
Total Quantities and Quantities/Unit of Product
In Production Unit # __________

	Manufactured	Processed	Otherwise Used	Byproduct	Releases and Transfers Off-site
Chemical 1 –Total Quantity					
Chemical 1 – Quantity/Unit of Product					
Chemical 2 –Total Quantity					
Chemical 2 – Quantity/Unit of Product					
Chemical 3 –Total Quantity					
Chemical 3 – Quantity/Unit of Product					

Table 2
Byproducts and Emissions in Production Unit # ___________

Byproducts: **Emissions:**

	Treated On-site	Treated Off-site	Recycled On-site	Recycled Off-site	Disposed On-site	Disposed Off-site	Released to the Environment
Chemical 1							
Chemical 2							
Chemical 3							

E. Options Identification, Evaluation, and Implementation

Overview of The Options Identification and Evaluation Process

This section of the guidance provides an overview to the process for options identification and technical and economic evaluation. It describes an "idealized" approach to the process, some considerations about the amount of analysis needed, and instances when the actual process may differ from the idealized approach.

The Toxics Use Reduction Act requires that the plan include for each covered toxic used in each production unit:

> "a *comprehensive economic and technical evaluation* of *appropriate* technologies, procedures, and training programs for *potentially achieving* toxics use reduction..." (emphasis added)

The regulations (310 CMR 50.45, 50.46 and 50.46A) establish the following general process for conducting that evaluation:

1) **Identify the universe of TUR options available to the facility**. Companies must identify all of the techniques for *potentially achieving* toxics use reduction that could possibly be implemented.

2) **Screen the universe**. Companies should conduct enough of a technical and economic analysis to determine if a technique is "not appropriate." A technique is not appropriate if it is clearly economically or technically infeasible or it would not result in TUR. Techniques that are not appropriate may be eliminated from further consideration.

3) **Decide which -- if any -- appropriate techniques to implement**. Companies must complete a comprehensive technical and economic analysis on all appropriate techniques. The analysis need only be sufficient to make a good faith business decision about whether or not to implement the techniques.

For those techniques the facility plans to implement, the regulations require that the following steps be taken:

4) **Develop an Implementation Schedule**. Companies must determine how long it will take them to put the selected techniques into practice.

5) **Project the reductions in toxic chemicals used, byproduct generated, and the Byproduct Reduction Index two and five years into the future**. These projections are made on the assumption that the selected techniques are implemented as planned. Note that while companies set these projections, they are not required by TURA to achieve them.

Example 8 provides a diagram of the options identification and evaluation process.

The decisions resulting from each phase of the analyses need to be included in the plan. Table 3 on page 35 is an OPTIONAL summary table that may be used to summarize the results of the entire options identification, screening and evaluation process. Using such a table will minimize the need to repeat information.

There are three important considerations to keep in mind during this phase of planning.

1) First, the amount of technical and economic analysis to determine if a technique is not appropriate or to decide to implement a technique will vary from technique to technique and from facility to facility.

The “good business decision” criterion applies here as elsewhere in the planning process. In other words, a company should conduct an analysis sufficient to be able to make a good business decision, as they would any other business decision.

Options may be deemed inappropriate and the evaluation stopped as soon as the planners have enough information to determine that the technique is clearly technically or economically infeasible and/or is not toxics use reduction. This screening evaluation could involve extensive research or analysis but it may be as simple as "back of the envelope" calculations or comments made during the brainstorming session in which the technique was first suggested.

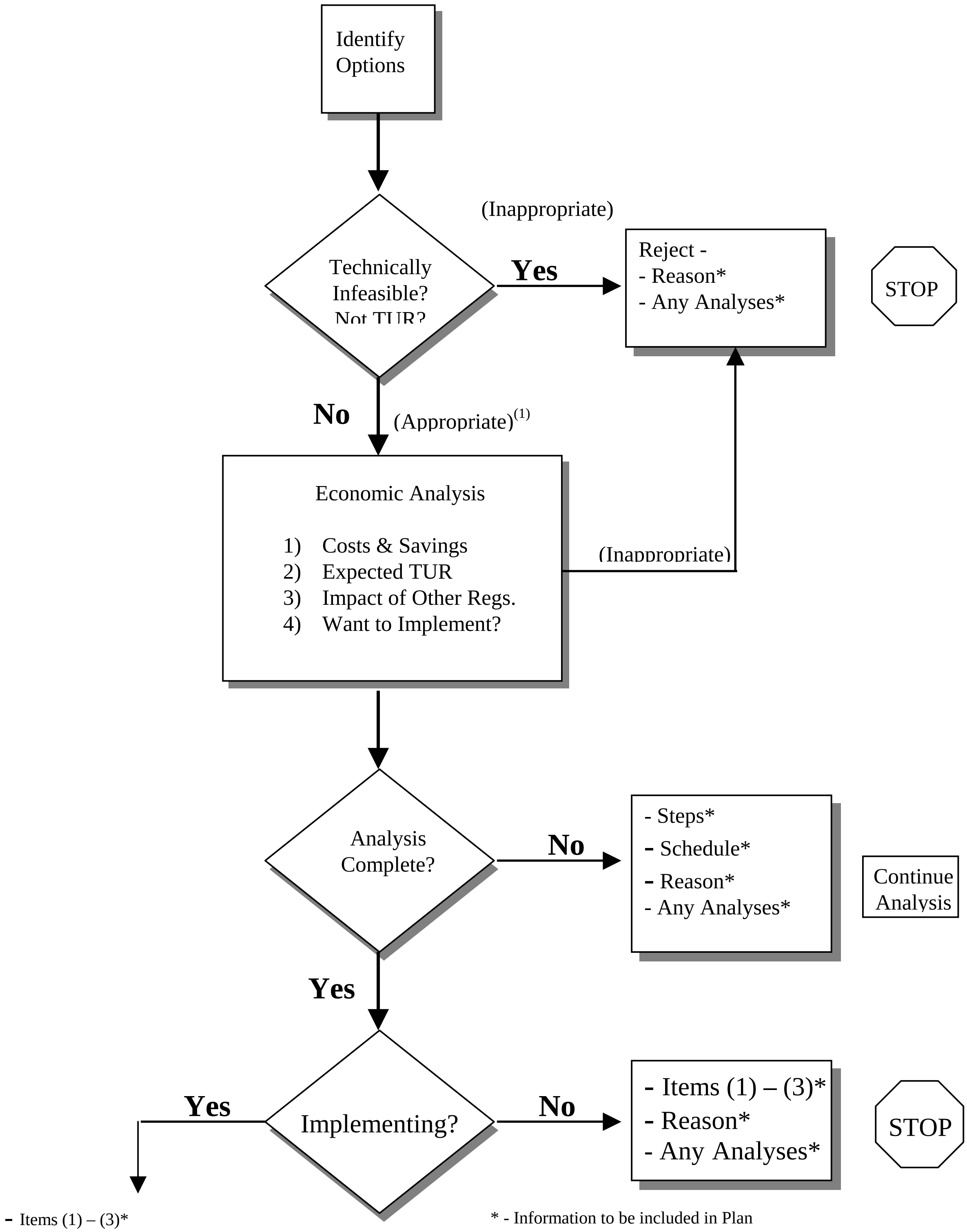
Examples of such simple technical and economic analyses completed during the brainstorming session itself include, “there is no room to install the equipment” or "we tried that last year and it didn't work." Another example would be a simple calculation that showed that a TUR technique would not be economically feasible because the annual cost of implementing the change would exceed the total annual cost of the toxic.

In other situations, the facility may need to do some research into the labor or capital implementation costs, or on the effects on product quality or customer acceptance before it obtains enough information to screen out the technique as clearly technically or economically infeasible.

Alternately, a facility may decide to implement a technique upon its identification, prior to completing any significant evaluation at all. Note that the required comprehensive evaluation would not be much different than what the company would need to do in order to implement the technique in the absence of TURA planning regulations. For techniques that are to be implemented, companies are required to determine the project's costs and savings, evaluate the project's impact on compliance with other regulations, determine the expected toxics use reduction, develop an implementation timetable and determine the two- and five-year projections of use, byproduct and BRI. The first four items would likely be done for any project. The only additional parts may be the two- and five-year projections.

Example 8

TUR OPTION IDENTIFICATION AND EVALUATION



* - Information to be included in Plan

(1) You may have enough information to know you want to implement an option at this point. If you know items (1) -(3), (5), & (6) at this point, the comprehensive technical and economic analysis has been completed.

2) The second major consideration for this phase of the planning process is that the options identification, evaluation, and decision making process is not likely to occur in as linear a fashion as described above.

Though the process of identification, evaluation and implementation of TUR techniques is described in a linear fashion, in all likelihood the process is likely to be non-linear. During the process, new techniques will be brought to light and evaluated, while others will drop out when they are considered inappropriate. Evaluating one approach may give rise to new ideas. Similarly, a facility may have to do an in-depth technical or economic analysis before they can determine that a technique should be screened out as not appropriate (clearly technically or economically infeasible). Finally, it is unlikely that all of the techniques will be in the same phase of the process at the same time.

3) The third major consideration is that it may not be possible to complete the evaluation of the technique prior to the date in which the plan must be completed.

For example, in some situations it may be necessary to do bench scale testing of a technique in order to determine impacts on product quality or to figure out whether the technique actually works. Or, some test marketing may be required to evaluate customer acceptance.

If the facility must do additional research before it can reach a decision about a technique, the plan must include a brief explanation of why the research cannot be completed by the due date of plan completion, and an implementation schedule for the additional research. Note that the facility may take extra time to complete an in-depth technical analysis such as the bench scale testing mentioned above. The company may then need to conduct a follow-up economic evaluation. However, it is not appropriate for a facility to take extra time to complete only the costs and savings analysis or to develop the projected use reductions.

~~Options Identification Procedure~~

The options identification procedure is designed to identify all options that could potentially achieve toxics use reduction. 310 CMR50.45(1) requires that companies describe the procedure they used to identify technologies, procedures, or training programs for potentially achieving toxics use reduction in each production unit. The plan also must include a list of technologies, procedures, or training programs identified by the options identification procedure as required by 310 CMR 50.45(2).

The options identification procedure needs to include consideration of each of the 6 types of toxics use reduction techniques (input substitution, product reformulation, production unit redesign or modification, production unit modernization, improved operation and maintenance, and recycling or reuse) defined in 310 CMR 50.10.

The plan needs to include a written description of the procedure used and its results, including:

- Personnel involved,
- Description of information sources consulted,
- Description of information gathering techniques,
- List of technologies, procedures or training programs identified.

This options identification process is not meant to be a burdensome paperwork exercise. Companies should demonstrate that they have gone through a considered process to identify TUR options.

It is important that the TUR team include people representing a variety of responsibilities and expertise in the company. The team members, either by brainstorming, or researching individually or collectively, should come up with a variety of options. All options that were identified must be included in the plan, regardless of when they were developed and even if they were immediately deemed inappropriate. Options that were evaluated prior to the development of the plan or formation of the TUR team may be included.

In the scope of the plan, companies also may choose to describe TUR practices that they have already implemented.

Screening the Options Identified

The options screening involves identifying any inappropriate options and eliminating them from further consideration. 310 CMR 50.46(2) provides the initial screening criteria to determine if a TUR option is inappropriate. The three criteria are:

- TUR technique is clearly technically infeasible,
- TUR technique is clearly economically infeasible,
- TUR technique will not result in a decrease in toxics use or byproduct per unit of product (i.e., it is not TUR).

It is important to remember that the amount of analysis needed to determine that a technique is inappropriate will vary from technique to technique and from facility to facility. Furthermore, an option can be deemed inappropriate at any point in the analysis. The analysis can stop as soon as this conclusion is reached. The regulations are structured so that options can be evaluated first for technical feasibility. Then the economic analysis need only be done on the feasible options.

A TUR technique may be clearly technically infeasible if, for instance: the equipment is not available or cannot be developed, worker skills are inadequate, the impact on product quality is unacceptable, or the space is insufficient to install the equipment. For a TUR technique to be clearly economically infeasible, factors might be that the technique does not meet the company's investment criteria or it does not seem feasible based on a rough analysis of costs and savings. Finally, factors to think about when determining if an option is TUR are:

- Does it reduce toxics use and/or byproduct generation? (Yes, it reduces toxics use and/or byproduct generation.)

- Does it shift all byproducts from one waste stream to another? (No, it does not shift all the byproducts from one waste stream to another.)

- Does it treat/recycle all byproducts outside of the production unit? (No, byproducts are not treated/recycled outside of the production unit.)

The plan needs to include the results of the screening steps and any analyses or studies done that led to the facility's conclusion about an option's feasibility. The reason why a TUR technique is inappropriate must be included in the plan. The analyses do NOT need to be reformatted or copied over. It is perfectly acceptable to include quick calculations done on a pad of paper during a brainstorming session, or a memo written to summarize the results of a bench test.

Example 9 demonstrates the screening process. The TUR team at Facility 9 identified four TUR options that fell under the category of improved operations and maintenance. Two were definitely technically feasible, the other two were not. The improved operations and maintenance methods varied in their potential for toxics use reduction.

Based on this screening analysis, the company rejected the two methods that were clearly technically infeasible. They quickly conducted a cost/savings analysis and determined that both options had good to excellent payback periods. The facility felt that the little technical and economic analyses they did to determine whether techniques which were considered inappropriate had given the facility enough information to decide to implement the two operations and maintenance techniques. The company documented these choices in the narrative and accompanying table.

Facility 9 also considered three input substitution methods. Applying the screening criteria, the company found that only one option, the ShipSolv parts cleaning solvent, had the potential to be technically feasible. Further, that option looked as though it would be economically feasible and would eliminate toxic chemical use (i.e., it is TUR). The ShipSolv chemical option was a candidate for further technical and economic evaluation. The two other options were rejected from further consideration because they were not technically feasible.

Evaluating Technical and Economic Feasibility [310 CMR 50.46 and 50.46A]

In this phase of TUR planning, TUR techniques that were identified in the first phase undergo an analysis to determine:

- Costs and savings associated with the option,
- Expected changes in the total use and byproduct generation and the use and byproduct amounts per unit of product from the amounts of use and byproduct in the planning year that would result from implementation of the option for a full year of operation at planning year production levels.
- Relationship between the option and other applicable laws and regulations including whether implementation will violate any other law or regulation.
- Whether or not the facility plans to implement the option and if so, an implementation schedule and the projected TUR.

Again, some or all of these bulleted items may already have been answered during the screening phase. Conversely, work done in this phase may reveal that a technique is actually inappropriate. Or, new options may be identified during this phase. Companies may go about the evaluation in whatever way they generally evaluate projects. The evaluation of any option is complete as soon as the option is deemed inappropriate or the bulleted items above are known.

The plan needs to include:

ALL appropriate techniques whether or not they are being implemented:

- Description of each appropriate technique,
- Information required in the bulleted items above,
- All technical and economic analyses that were done (Note: facilities are encouraged to simply append these in their original form as calculations, spreadsheets, memos, reports, etc.).

Appropriate techniques that will not be implemented:

- Reasons why an option is not being implemented (these may be technical, economic, or a combination of the two).

Appropriate techniques that are being implemented:

- Implementation schedule (include the start date of implementation),
- Projected total and per unit of product changes in use and byproduct generation for the chemical/production unit combination in 2 years and 5 years. [See 310 CMR 50.46(1)(b)]. These changes are based on the amounts used and generated in the year on which the plan is based),

- Projected BRI for the chemical/production unit combination in 2 years and 5 years [See 310 CMR 50.44(8), by definition the BRI is always calculated from the base year in the TUR reports.]

Finally, if the company has not completed its full technical and economic evaluation by the time the plan is due, the plan needs to include:

- Description of the option,
- Description and schedule of the steps to be taken to further evaluate the option,
- Explanation of why the evaluation cannot be completed by the due date of the plan, and
- Analyses completed to date.

Optional Tables 4, 5, and 6 may help companies organize the information to be included in the plan for appropriate techniques whether they are ones to be implemented, not implemented, or requiring further study.

Technical Evaluation [310 CMR 50.46]

The technical evaluation is done to assess the benefits and drawbacks of the TUR techniques that are appropriate. There are no explicit criteria for a technical evaluation. As mentioned above, companies need to employ good engineering practices and plan in good faith. Companies may go about the evaluation in whatever way they generally evaluate projects. Companies need to have completed enough of an analysis and documented it sufficiently to make the technical conclusions listed above and to make a good business decision about whether or not they will implement the technique.

Some considerations that may be useful in doing the technical evaluation are: reliability of the technique, implementation time, effect on worker health and safety, effect on product quality, space requirements, utility requirements, worker skills/experience required, worker acceptance, need for preliminary research and development and/or testing, environmental impact, need for additional equipment, expected TUR, and impact of other regulations.

Economic Evaluation [310 CMR 50.46A]

TURA filers are not required to identify all costs associated with the use of all reportable toxics in all production units and to calculate total costs per unit of product. Instead, filers are required to consider all direct and indirect costs that are relevant to the economic evaluation of feasible toxics use reduction options when they perform financial analyses of those options. Where no technically feasible options are available, filers must identify, but not necessarily quantify, the costs associated with using the toxic chemical.

In evaluating costs, only the incremental costs need be considered, i.e., costs of the existing process that will be avoided and those new costs, including initial and operating costs that will be incurred. Indirect costs, such as storage or insurance, are not typically charged to products or processes. Estimates may be used as long as the assumptions are stated.

First time filers and /or new TUR Planners may find it beneficial to collect detailed cost information on all or most toxics and production units in order to fully understand the costs associated with the use of toxics in their facilities and to help prioritize TUR opportunities.

The economic evaluation provides a comparison between the baseline (i.e., current) process and the alternative process that includes the TUR technique. The economic evaluation of the TUR option tells a company whether or not it makes economic sense to proceed with implementing the TUR option. It is important that this evaluation be as detailed as any other capital budgeting exercise the company undertakes.

This economic evaluation must identify all relevant costs and savings associated with implementing the option including those costs that reside in overhead accounts. These costs may include environmental compliance costs and fees. A list of costs that may be appropriate to consider is shown in Example 10.

While the facility may evaluate the costs and savings in whichever way it chooses, the facility should use the same depreciation rate, cost of capital, and economic performance criteria (e.g., payback period, internal rate of return, net present value) it would normally use for capital budgeting, assuming the facility typically considers these factors in capital budgeting decisions. However, the facility does not need to base its decision to implement an option on as stringent factors as it normally uses. It might, for example, allow a longer payback period or lower rate of return for a technique that reduces byproduct from a chemical that has a high potential for liability.

The plan must include the economic calculations performed. The labor and material rates should be specified, as should the depreciation rates, cost of capital, and economic performance criteria used.

In Example 11, Facility 11 has evaluated the costs and savings associated with implementing solventless coating operation. Facility 11 used a net present value (NPV) analysis and rate of return (ROR) calculation. The company used their standard 20% rate of return. In their cost calculations, they considered the savings resulting from not having to purchase toluene, the reduced labor and disposal costs and yield increases.

The savings associated with reduced labor costs for compliance were developed from the impact analysis of other regulations. These costs included capital, research and development and testing. Facility 11 projected the costs over a 10-year estimated life of the project.

In this economic analysis, Facility 11 stated their assumptions about the rate of return, increases in the cost of material and their exclusion of income taxes, depreciation, and salvage value from the evaluation. If the initial calculations of ROR were closer to the 20% benchmark, the company would have undergone a more extensive economic analysis that included evaluation of the impact of income taxes, depreciation, and salvage value. Since the project did not seem to be viable at the time, the company stopped the analysis at the point it felt it had sufficient information to make a decision.

Keep in mind that all of the assumptions, costs, and savings are company specific. Companies do not need to use the specific assumptions and categories of costs and savings shown in this example, but companies do need to state their own assumptions and show the costs and savings in the plan.

In Example 12, Facility 12 compared three different options. Throughout the discussion, the company described its financial analysis method, assumptions, and costs and savings categories. The facility also learned after their options screening that their low cost option did not meet the facility's criteria for a one-year payback. Instead, they decided to do further testing and evaluation of a higher cost option which had a significantly higher net present value, higher profitability index, and payback period of less than one year. It should be noted that the facility chose to perform the economic evaluation of options on a before-tax basis and excluding depreciation of capital expenditures. It is, however, recommended that economic evaluations be performed on an after-tax basis and that depreciation is included. This gives a better indication of the real cash flows.

After completing the options identification and technical/economic evaluation, companies must develop an implementation schedule for all TUR techniques that will be implemented. Example 12 shows an implementation schedule.

Table 3

OPTIONAL

OPTIONS IDENTIFICATION AND EVALUATION SUMMARY FORM

Production Unit # __________ Chemical _________________________

OPTION		**Appropriate?**	**Implementing?**	**Reason Why Inappropriate Or Not Implementing**
#	**Description**			

(Append any technical and economic analyses and calculations)

Example 9

TUR Option Development and Screening

Facility 9
Production Unit: Floatation Device Production
Chemical: Methylene Chloride

When it began TUR planning in January 1993, Facility 9 decided that it would incorporate the TUR planning process into its ongoing effort toward continuous improvement. The facility's past experience was that new ideas for production changes were conceived, tried out, permanently implemented, or set aside depending on results and practical experience. Toxics use reduction options generated through TUR planning would undergo the same implementation process, and would employ as screening criteria the factors that the company has found to work through its past experience. The TUR planning process would serve primarily as a way for the company to systematize and document its method of pursuing process efficiency improvements and presenting potential investments to management.

TUR Techniques were identified based on a process review, ideas from management and employee "brainstorming" sessions held as part of TUR team meetings, and information from literature reviews. Each of the six TUR techniques was discussed in order to identify all appropriate options. Initially, all ideas were considered regardless of scope, economic, and technical considerations. Options considered ranged from minor operational changes to chemical substitutions and process changes. Input regarding the technical practicality of potential strategies was gathered and an initial cut of options which were not viable from either a technical or marketing standpoint was made.

Criteria used to determine the appropriateness of the listed strategies fell into three categories: technical feasibility, whether or not the option was toxics use reduction, and economic feasibility. Those strategies which were determined to be technically infeasible were the first to be eliminated. Factors used in assessing technical infeasibility of a strategy included: excessive labor requirements; time requirements which would interfere with the overall production schedule; quality requirements; and unavailability of equipment. Marketing impacts were not anticipated for changes in the use of methylene chloride, since it is used in an ancillary operation and is not directly related to product quality.

The second criteria was projected environmental benefit, including TUR chemical reductions and reductions in regulated discharges. Strategies which would result in no environmental benefit were eliminated. Those techniques which would result in only marginal reductions were not considered further if they required significant costs or process modifications. Strategies which involved the substitution of materials underwent further study to determine the environmental impact of the new material. In the event that the new material also contained TUR chemicals or would contribute to a regulated discharge than the relative toxicity of the two materials, the quantity of byproduct, and the amount of regulated discharge generated were examined. An initial assessment of the potential reductions which could be expected for possible strategies was discussed and was used as a means of prioritizing strategies for further study and review.

Example 9 (continued)

An initial payback analysis of the current costs associated with chemical use and waste generation and the anticipated costs of selected strategies was made. A detailed economic assessment was made for those selected strategies which had higher projected costs.

All options were classified into one of three groups: appropriate -- full immediate implementation without further study, appropriate -- further study or implementation with testing as part of TUR plan development, and inappropriate -- elimination from further consideration. Several strategies were identified which could be readily implemented at little cost. These strategies were selected without further study. Other promising strategies identified required research both to determine their true applicability and to gather information regarding costs and implementation requirements.

Flotation Devices Production Unit - Methylene Chloride

Methylene chloride is used for cleaning molds and other parts in the flotation devices production unit. Several potential TUR techniques were identified for the reduction of methylene chloride in the flotation devices production unit as described below. See the table below for a list of all TUR techniques considered.

<u>On-Site Recycling</u>

In 1991a batch still for on-site distillation and recycling was installed to reduce methylene chloride purchases. It was not practical to hardpipe the still to the parts washing tank. This still reduced new purchases (facility-wide use) and emissions of methylene chloride per unit of product by about 75%, to 10,000 pounds per year in 1991. However, the generation of byproducts per unit of product did not change. Because of the overall environmental benefits, use of the distillation unit will continue as long as methylene chloride is used at the facility.

<u>Use of Disposable Aluminum Mold Liner</u>

Lining the mold with a disposable aluminum mold liner was tested and found to be ineffective. The aluminum could not be properly shaped to fit the mold. This option was eliminated as technically infeasible.

<u>Use of Disposable Plastic Film Mold Liner</u>

Lining the mold with a disposable plastic mold liner was tested and found to be ineffective, since the plastic melted. This option was eliminated as technically infeasible.

<u>Use of a Disposable Plastic Blow Molded Mold Liner</u>

The option of fabricating a durable polyethylene plastic liner through a blow-molding process appeared to be technically feasible. This option had a good potential for reducing toxics use because it would completely eliminate the use of 32,000 pounds per year of methylene chloride. The economic feasibility of the option was considered good, with an estimated payback period of about six months.

Example 9 (continued)

This option was elected for implementation on a trial basis during the planning period. Several disposable polyethylene mold liners were fabricated by a job shop and were tested. The method worked well and eliminated the need for methylene chloride use in this process step. It also created unexpected labor savings and a faster than anticipated payback because it was easier to extract the cast product from the mold. The disposable polyethylene liner, which adhered to the work piece, could then be easily cut and removed as part of the parts trimming process. Consequently, this option was selected for full implementation. A capital investment of $5,000 was made to make a permanent metal mold for fabricating the polyethylene mold liners. Full implementation began in November of 1993 and was completed by February 1994.

Restricted Access to Methylene Chloride

Access to methylene chloride was restricted and recorded. This action was taken both to discourage methylene chloride use and to improve knowledge of how it was used. The chemical was placed under lock and key; employees had to make a request and record the amount used and its purpose in a log book. After three months use, the chemical per unit of product was reduced by almost 20%. Implementation of this TUR strategy will continue.

Use of Citric Acid Based Cleaners

Several substitute cleaners (semi-volatile citrus-based terpenes) offered by vendors have been tested but do not effectively clean the molds, so their use has been discontinued and will not be considered as a TUR option any further.

Use of Acetone as a Cleaner

Acetone did not clean the molds as well as methylene chloride. In addition, acetone is a TUR chemical and is extremely flammable, presenting additional safety hazards and storage requirements. The use of acetone will not be considered.

Use of ShipSolv Cleaner

"ShipSolv", a less toxic solvent containing butyrolactone (CAS 96-48-0) or gamma-butyrolactone was considered as an option. The ShipSolv product removed the epoxy, though more slowly than methylene chloride. The TUR team decided to further test and evaluate substitution of this product for methylene chloride in parts cleaning steps. A full technical and economic evaluation of the potential uses and limitations of ShipSolv will therefore be conducted.

Example 9 (continued)

Toxics Use Reduction Option Screening

Flotation Devices Production Unit - Methylene Chloride Use for Parts Cleaning

Toxics Use Reduction Option	**Option Type**	**Technical Feasibility**	**Is it TUR?**	**Economic Feasibility**	**Appropriate/ Inappropriate?**
Develop disposable mold liner-plastic blow molded	Improved O & M or production unit equipment and methods	Feasible - requires capital investment (larger mold)	yes	Feasible - potential payback in 6 months (labor saving in tool preparation)	Appropriate - immediate implementation
Use disposable roll form aluminum as mold liner	Improved O & M or production unit equipment and methods	Infeasible - could not form to tool during test	yes	Feasible - potential payback in 6 months (no capital costs)	Inappropriate
Restrict access to methylene chloride	Improved O & M or production unit equipment and methods	Feasible	yes	Feasible - actual payback less than 3 months	Appropriate
Use disposable plastic sheet film	Improved O & M or production unit equipment and methods	Infeasible - ineffective in test (melted)	yes	Feasible - potential payback in 6 months (no capital cost)	Inappropriate
Use citric acid based parts cleaning substitute for solvents (terpene)	Input Substitution	Infeasible - failed to remove epoxy residue in test	yes	Feasible – payback in one year	Inappropriate
Use acetone as substitute parts cleaning solvent	Input Substitution	Infeasible - failed to remove epoxy residue in test	yes	Feasible – payback in one year	Inappropriate
Use ShipSolv as substitute parts cleaning solvent	Input Substitution	Feasible - fair results in test (removed epoxy more slowly than methylene chloride)	yes	Feasible – payback in one year	Appropriate - conduct further testing/evaluation
On-site recycling	On-site recycling - not integral	Feasible	no	--	Inappropriate

Example 10

Typical Costs and Activities to Consider in Pollution Prevention Economic Analysis

USUAL COSTS

depreciableCapital Costs
Engineering
Procurement
Equipment
Materials
Utility connections
Site preparation
Facilities
Installation

Operating Expenses
Start-up
Training
Initial raw materials
Working capital
Raw materials
Supplies
Direct labor
Utilities
Maintenance
Salvage value

Operating Revenues
Revenues
Byproduct revenues

COMPLIANCE COSTS

Receiving Area
Spill response equipment
Emergency response plan

Raw Materials Storage
Storage facilities
Secondary containment
Right-to-know training
Reporting and record-keeping
Safety training
Safety equipment
Container labels

Process Area
Safety equipment
Right-to-know training
Waste collection equipment
Emission control equipment
Sampling and testing
Reporting and record-keeping

Solid & Hazardous Waste
Sampling and testing
Containers
Labels and labeling
Storage areas
Transportation fees
Disposal fees

Air & Water Emissions Control
Permit preparation
Permit fees
Capital costs
Operating expenses
Recovered materials
Inspection and monitoring
Record-keeping and reporting
Sampling and testing
Emergency planning
Discharge fees

OVERSIGHT COSTS

Purchasing
Product/vendor research
Regulatory impact analysis
Inventory control

Engineering
Hazard analysis
Sampling and testing

Production
Employee training
Emergency planning
Medical monitoring
Re-work
Waste collection
Disposal management
Inspections and audits

Marketing
Public relations

Management
Regulatory research
Legal fees
Information systems
Penalties and fines
Insurance

Finance
Credit costs
Tied-up capital

Table 4
OPTIONAL
OPTIONS IDENTIFICATION AND EVALUATION SUMMARY FORM
APPROPRIATE OPTIONS THAT WILL NOT BE IMPLEMENTED

Production Unit # __________ Chemical _________________________

Option # Option Description			
Reason Why Not Implementing			
Expected Changes (lbs.)	Use	Per Unit of Product:	Annual:
	Byproduct	Per Unit of Product:	Annual:
Annual Costs			
Annual Savings			
Other Regulations			

(Append any technical and economic analyses and calculations)

Table 5
OPTIONAL
OPTIONS IDENTIFICATION AND EVALUATION SUMMARY FORM
APPROPRIATE OPTIONS THAT ARE BEING IMPLEMENTED

Production Unit # __________ Chemical ____________

Option # Option Description			
Implementation Schedule			
Expected Changes (lbs.) (in planning year)	Use	Per Unit of Product:	Annual:
	Byproduct	Per Unit of Product:	Annual:
Projected Changes (lbs.) (from the year on which the plan is based)	Use in 2 years	Per Unit of Product:	Annual:
	Use in 5 years	Per Unit of Product:	Annual:
	Byproduct in 2 years	Per Unit of Product:	Annual:
	Byproduct in 5 years	Per Unit of Product:	Annual:
Projected BRI (from base year)	In 2 years		
	In 5 years		
Annual Costs			
Annual Savings			
Relationship to Other Regulations			

(Append any technical and economic analyses and calculations)

Table 6
OPTIONAL
OPTIONS IDENTIFICATION AND EVALUATION SUMMARY FORM
OPTIONS REQUIRING FURTHER STUDY

Production Unit # __________ Chemical _________________________

Option # Option Description	
Reason Why Evaluation Cannot Be Completed By Plan Deadline	
Steps and Schedule For Completing Evaluation	

(Append any technical and economic analyses and calculations completed to date)

Example 11

Economic Feasibility Evaluation

Facility 11
Production Unit: Mixing and Coating Operations
Project Title: Solventless Coating Development and Implementation
Chemical: Toluene
Expected TUR: 25%

Based on the TUR Planning Team's assessment of various options, it has been determined that the development of a new coating formulation process is a technically feasible option for some of the facility's products. The new technology uses mechanical means to prepare rubber compounds into a workable texture without the use of toluene in the process. Current production methods utilize toluene to create a solution which is coated onto a substrate. It is projected that the new production method applied to one product line could reduce the use of toluene by 25%. Toluene byproducts and emissions would be reduced by the same amount.

Preliminary research indicates that successful implementation of this major process modification will also yield a higher quality and more consistent product. Currently, this modification is only considered to be technically feasible for the facility's A1000 line of printing blankets.

In order to evaluate this option, a net present value analysis was performed. A 20% rate of return (ROR) was applied to all anticipated savings and costs projected over the economic life of the project, which the facility's marketing department estimates is 10 years. This ROR is standard for all of the facility's capital appropriations. Assumptions used in the analysis are a 3% annual increase in the cost of materials, labor and disposal costs and a 3% annual increase in the value of increased production. Income taxes, depreciation, and salvage value of the new equipment were not considered in this initial analysis. If the analysis showed the ROR to be close to the target 20% rate of return, a more detailed analysis including these factors would be done. The salvage value for the replaced equipment was considered.

The spreadsheet on pp. 48-49 contains a breakdown of the areas in which savings would be expected from the anticipated reduction of 25% in the use of toluene. All known or anticipated savings and costs have been projected out to 2003 and adjusted into present (1993) dollars.

Description of Savings

Facility 11 anticipates that direct production labor would be reduced as a result of the new production method. Current mixing and coating operations for this family of products requires six employees. It is projected that 1/2 of an employee could be reassigned in the second year and a full employee could be reassigned beginning in the third year.

Disposal costs would also be reduced by making this change, and those savings are evaluated in the table. It has been assumed that a reduction in purchasing toluene by 25% would also result in a 25% reduction of toluene wastes.

Example 11 (continued)

Indirect compliance labor, which includes the cost of labeling barrels, handling drums, and completing reports and manifests, is expected to decrease by 15%.

Other costs that were considered are storage costs, insurance premiums, and training costs. It was not possible to project any reductions in these areas because these costs would probably remain the same until toluene is totally eliminated from production.

The major projected cost advantage in going to a solvent-less system is that bench scale R&D has shown that this new production method will produce a higher quality product and a higher yield. Presently, there is no simple way to arrive at the dollar value for this increase, but a figure of $70,000 was felt to be realistic and could be seen in the second year of production. This value would also increase by 3% annually.

Miscellaneous savings from reduced power consumption, reduced maintenance, and freed space are presently undocumented, but are estimated to be $30,000 in the first year of operation, and were also assumed to increase by 3% each successive year of the project life.

The stainless steel mixing tanks for this product line are expected to be sold for scrap. Based on the current price of steel, $10,000 is expected from the removal and sale of the tanks. This savings is not expected until the second year of the project.

Description of Costs

The new equipment purchase costs will be paid out of a capital appropriation fund which will be paid in full at the beginning of the project. Installation and start-up costs also will be paid at the beginning of the project.

The research and development plan for this project is projected to run over the next two years with a budget of $75,000 each year. These costs will be considered to be paid out after the end of the first year and at the end of the second year. Along with the R&D program, a pilot test procedure must be performed to test the new products. It is estimated this will cost an additional $50,000 over a three-month trial period at the beginning of the first year.

While power consumption will be less, the new calendar process is expected to create a cost due to regular roller refurbishment and periodic replacement. This will add about $20,000 a year to the project in the first full year of operation, and is expected to increase 3% annually.

Summary

In comparing the net present value of the projected savings against the projected costs, at the facility's standard ROR of 20%, the project is not met. Based on this analysis, Facility 11 will not proceed immediately with the implementation of this project. However, due to the potential for completely eliminating the use of toluene and potential product improvements, Facility 11 has decided to continue funding its R&D efforts for this process. The facility will reevaluate its feasibility annually as cost estimates solidify, and other factors such as disposal and labor costs change.

Example 11 (continued)

ITEM	1993	1994	1995	1996	1997	1998	2001	2000	2001	2002	2003	TOTAL
PURCHASE OF TOLUENE												
SAVINGS \COSTS	$0	$12,740	$13,123	$13,516	$13,922	$14,339	$14,770	$15,213	$15,669	$16,139	$16,623	$146,055
PRESENT DOLLARS	$0	$10,617	$9,112	$7,822	$6,714	$5,763	$4,946	$4,246	$3,645	$3,128	$2,685	$58,678
PRODUCTION LABOR												
SAVINGS\COSTS	$0	$0	$20,600	$42,436	$43,709	$45,020	$46,371	$47,762	$49,195	$50,671	$52,191	$397,955
PRESENT DOLLARS	$0	$0	$14,305	$24,558	$21,081	$18,094	$15,530	$13,330	$11,443	$9,820	$8,429	$136,589
DISPOSAL												
SAVINGS\COST	$0	$20,000	$20,600	$21,218	$21,854	$22,509	$23,186	$23,881	$24,598	$25,336	$26,095	$229,276
PRESENT DOLLARS	$0	$16,666	$14,305	$12,279	$10,540	$9,047	$7,765	$6,665	$5,721	$4,910	$4,214	$92,112
COMPLIANCE LABOR												
SAVINGS\COSTS	$0	$4,500	$4,635	$4,774	$4,917	$5,065	$5,217	$5,373	$5,534	$5,700	$5,871	$51,587
SAVINGS IN PRESENT DOLLARS	$0	$3,750	$3,219	$2,763	$2,372	$2,036	$1,747	$1,500	$1,287	$1,105	$948	$20,725
YIELD AND QUALITY INCREASE												
FUTURE EARNINGS	$0	$0	$70,000	$72,100	$74,263	$76,491	$78,786	$81,149	$83,583	$86,091	$88,674	$711,137
PRESENT VALUE	$0	$0	$48,608	$41,724	$35,817	$30,742	$26,385	$22,649	$19,442	$16,684	$14,321	$256,372
MISCELLANEOUS SAVINGS												
SALVAGE STEEL	$10,000											$10,000
AFTER NEW PROCESS	$0	$30,000	$30,900	$31,827	$32,782	$33,765	$34,778	$35,822	$36,896	$38,003	$39,143	$343,916
PRESENT DOLLARS	$0	$24,999	$21,457	$18,418	$15,811	$13,570	$11,647	$9,998	$8,582	$7,365	$6,322	$138,169
PRESENT WORTH OF SAVINGS												$712,644
NEW EQUIPMENT												
CAPITAL	$500,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$500,000
ROLLER REFURBISHING	$0	$20,000	$20,600	$21,218	$21,855	$22,510	$23,185	$23,881	$24,597	$25,335	$26,095	$229,278
PRESENT DOLLARS	$0	$17,000	$17,510	$18,035	$18,576	$19,134	$19,708	$20,299	$20,908	$21,535	$22,181	$194,886

Example 11 (continued)

INSTALLATION												
CAPITAL	$75,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$75,000
STARTUP												
CAPITAL	$40,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$40,000
R&D EFFORT												
CAPITAL	$0	$75,000	$75,000	$0	$0	$0	$0	$0	$0	$0	$0	$150,000
COST IN PRESENT DOLLARS	$0	$62,498	$52,080	$0	$0	$0	$0	$0	$0	$0	$0	$114,578
PILOT TESTING												
CAPITAL	$100,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$100,000
COST IN PRESENT DOLLARS	$100,000	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$100,000
COST IN PRESENT DOLLARS												$921,690
NET PRESENT WORTH												($209,046)

Example 12

Economic Feasibility Evaluation

Facility 12
Production Unit: #4 - Film Integrated Circuitboard Manufacturing
Project Title: Glycol Ether Reduction/Replacement
Chemical: Glycol Ether
Expected TUR: 100%

Based on its initial screening, Facility 12 has determined that there are three technically viable options which could significantly reduce the glycol ether used in the production unit. Each option involves significant upfront costs and no clear economic advantage was identified. All three options were therefore subjected to a full economic evaluation.

Option 1 involves hard-pipe recycling of the photoresist stripping solution from the second stripping step to the first stripping step. This would save 50% of the current usage of glycol ether. Option 2 involves the 100% substitution of a non-TUR listed chemical, anhydrous citric acid, for the current stripping solution. This option would involve a new storage tank and piping, due to the incompatibility of the chemical with the currently-used stripping tank. Option 3 involves another 100% input substitution using a hydroxide/carbonate alkaline stripping solution. The spent solution could be piped to the facility's wastewater treatment plant, rather than the existing on-site storage tank. Thought had been given to using Option 2 or 3 as a long-term solution, to be switched to after initial implementation of Option 1.

The TUR team developed estimates of the new equipment purchase and installation costs for each option. In addition to these initial capital and installation costs, all options required some further testing and development prior to full implementation to re-qualify the products according to specifications, since they involved a change in the production process. The TUR team obtained estimates of the probable time and labor cost involved for both development labor and development product quality testing from the company's Research and Development section. These costs were added to new equipment purchase and installation costs to determine the total capital and one-time costs of project implementation (the initial investment amount, to be used in subsequent evaluation).

The TUR team conducted a full economic evaluation of the three options summarized in the table on p. 52. The analysis was completed in September 1993. The TUR planner in the company obtained data from the accounting department and process engineers to conduct the evaluation. Three indices of economic feasibility were calculated: 1) a simple payback period (years); 2) the Net Present Value (NPV); and 3) a profitability index (the net present value of total cash inflows divided by the initial investment amount). A discount rate of 15% was selected for use in the evaluation. In accordance with its TUR Management Policy, Facility 12 has no set minimum rate of return for TUR projects, though typically a payback period of one year or less is considered favorable. The 15% ROR was suggested by the accounting department as a reasonable midpoint that would require a moderately good return on investment for a TUR project to be considered feasible. Due to the typical short lifetime of a process at the facility, a three-year period was selected as the project lifetime for each option. January 1, 1994 was selected as the assumed start date for implementation.

Example 12 (continued)

The three economic indices all required estimation of the annual changes (savings or increased cost) in six areas of operating costs: 1) chemical purchase; 2) production labor; 3) treatment and disposal; 4) regulatory labor and fees; 5) utilities; and 5) ongoing laboratory product testing and analysis. The TUR planner had previously estimated the current cost for each of these categories from committee input. The annual changes from the current cost of toxics in each area were projected for each operating cost area over the next three years, using an assumed 3% inflation rate for labor, raw material purchase, and disposal costs. The net present value of savings in each future year were determined using the appropriate present value factors, and summed. The table on p. 52 summarizes the initial year (1994) direct savings or increased cost and the total net present value of all savings or costs over the three-year period to show where the major cost savings or increases occurred.

The results surprised the committee and led to a change of expected direction. The completed analysis indicated that Option 1, previously considered a good first step, would have a payback period of 1.53 years, greater than the facility's one-year rule of thumb for an acceptable investment, and only a moderate rate of return. With a total present value of $38,406, this was an acceptable investment at a 15% discount rate, but not an outstanding one. The chemical purchase savings of this option were partly offset by the higher cost of testing and analysis, and the initial product quality testing and development labor. Option 2 is economically infeasible (negative payback and net present value). The higher chemical purchase costs, ongoing testing cost increases, and need for a high initial investment in equipment, overweigh the moderate treatment and disposal cost savings of this option.

However, Option 3 appears to be an excellent investment. This option has high chemical purchase savings as well as moderate savings in production labor, treatment and disposal, after only a moderate initial investment. It has a projected payback period of only 0.39 years, a high net present value of $665,741, and a much higher profitability index than Option 1 (5.926 as compared to 1.3491). In addition, there were several qualitative economic benefits. Option 3 will improve the wastewater treatment process (the alkaline wastewater can neutralize acids from other waste streams) and its use reduced potential liability to the company stemming from the concern of female production workers about the impact of glycol ethers on their reproductive capacity.

Based on the results of the analysis, the company has decided to proceed immediately to further development testing and eventual implementation of Option 3, without prior implementation of Option 1. This option will produce a BRI and ERI of 100 for this production unit by 1995.

Example 12 (continued)

Economic Evaluation of Options for Reduction of Use of Glycol Ethers in Film Integrated Circuit Board Manufacture Production Unit, Photoresist Stripping Operation

	Option 1 - Recycle Photoresist Stripping Solution	Option 2 – Substitute Citric Acid -Based Stripper	Option 3 – Substitute Hydroxide/Carbonate Stripper
Capital & One-Time Costs of Option Implementation			
New Equipment Purchase (piping, tanks)	$ 50,000	$250,000	$ 50,000
Installation – Labor	$ 40,000	$ 50,000	$ 10,000
Development – Product Quality Testing	$ 10,000	$ 20,000	$ 25,000
Development – Labor	$ 10,000	$ 5,000	$ 50,000
Total of Capital & One-Time Costs	$110,000	$325,000	$135,000
Annual Operating Savings (Costs)			
Chemical Purchase			
Initial Year Savings *(Costs)*	$ 67,000	($103,000)	$207,000
Total Present Value of Savings *(Costs)*	$151,576	($233,020)	$468,301
Production Labor			
Initial Year Savings *(Costs)*	0	0	$ 20,000
Total Present Value of Savings *(Costs)*	0	0	$ 46,918
Treatment/Disposal			
Initial Year Savings *(Costs)*	$ 25,000	$ 50,000	$100,000
Total Present Value of Savings *(Costs)*	$ 58,648	$117,296	$234,592
Regulatory Labor & Fees			
Initial Year Savings *(Costs)*	0	$ 1,000	$ 2,000
Total Present Value of Savings *(Costs)*	0	$ 2,282	$ 4,565
Utilities			
Initial Year Savings *(Costs)*	0	0	$ 20,000
Total Present Value of Savings *(Costs)*	0	0	$ 46,918
Testing & Analysis Labor			
Initial Year Savings *(Costs)*	($20,000)	($20,000)	($ 5,000)
Total Present Value of Savings *(Costs)*	($46,512)	($46,512)	($11,628
Total Initial Year Savings *(Costs)*	$ 72,000	($72,000)	$344,000
Total Present Value of Operating Savings *(Costs)*	$148,406	($175,259)	$800,741
Payback Period *(Years)*	1.53	(-4.51) No payback	0.39
Net Present Worth at 15% Discount Rate	$ 38,406	($500,259)	$665,741
Profitability Index	1.3491	(-0.539) Unprofitable	5.926

Example 13

Selected Techniques Implementation Plan

Facility 13
Production Unit: #2 - Plastics Manufacturing
Chemical: Turacet

A summary of the implementation status for each selected TUR technique for the above production unit is provided below. Most selected techniques were implemented almost immediately after their advantage was identified or quantified. Potential issues which may cause the project to be delayed are also presented.

The toxics use management team will solicit periodic (quarterly) status reports regarding the projected implementation of each of the four selected techniques. Milestones and completed projects will be documented with internal memos. Expected delays will be identified at the beginning of the project. If there are any unforeseen delays that occur during project implementation, the reasons for the delay along with a revised timetable will be documented by internal memos. These memos will be forwarded to the chairman of the team and reported to the Plant Manager.

Adjustments to any of these techniques will be made as conditions and knowledge warrant. These changes and any new TUR ideas will be discussed at regular team meetings. Any ideas that are determined to have merit will be documented and further evaluated.

Example 13 (continued)

2) NEW PROCESS FILTER

The new filter will offer a better performance over the existing process filters resulting in a greater quantity of Turacet reclaimed. Implementation of this technique involves purchase and installation of new filters. No other modifications to the filters system need to be made.

Implementation date: 1 day

Completion date: Done

3) LEAK DETECTION AND REPAIR (LDAR) PROGRAM

The LDAR program will reduce fugitive emissions from vapor leaks from fittings in equipment by scheduling inspections, testing and repairs on a regular basis. This involves development of a large database of all potential leak points and identifies when they should be tested. Written procedures, purchase of leak detection equipment, and employee training also are required to implement this program. Three people have been assigned to this project as a supplement to their regular duties.

Implementation date: 7/1/94

Expected delays: This program may encounter delays if leak sensing equipment cannot be acquired. This is not likely to be a problem.

Projected completion date: 6/30/96

4) RECYCLE OF PROCESS LIQUID WASTE STREAM

The recycling of wastes will reduce the amount of raw material input. Steps required to implement recycling include specification and purchase of recycling equipment, plumbing recycle streams directly into the process, and training employees on the operation of the new equipment. In addition, a start-up testing period will be required to ensure that product quality is maintained.

Implementation date: 7/1/94

Expected delays: Delays may be caused by any impact the recycling efforts may have on product quality. Adjustments to the process and/or recycling efforts may take unforeseeable amounts of time to correct.

Estimated completion date: 9/30/95

F. Certification Requirement [310 CMR 50.42(3) and (4)]

Once the plan has been developed it must be certified by the senior plant manager and a MassDEP certified Toxics Use Reduction Planner. A senior plant manager is an official who has management responsibility for the persons or team completing the plan, and who has authority to act as an agent for the toxics user. The senior manager certifies the accuracy of the statements in the plan and the information used in it, based on the manager's inquiry of persons immediately responsible for developing the plan. The toxics use reduction planner certifies that, in his or her professional judgment, the planning process and the plan conform to MassDEP regulations.

The following page contains the required regulatory language for the certification statements by the senior manager and the toxics use reduction planner.

Certification Statement

Based on my independent professional judgment as a Toxics Use Reduction Planner, I certify under penalty of law that the following is true:

(a) I have examined and am familiar with this Toxics Use Reduction Plan;
(b) the Plan satisfies the requirements of 310 CMR 50.40; and
(c) the Plan demonstrates a good faith and reasonable effort to identify and evaluate toxics use reduction options.

______________________________________ ____________________

Signature of Toxics Use Reduction Planner Date

____

Print name of Toxics Use Reduction Planner

I certify under penalty of law that the following is true:

(a) I have personally examined and am familiar with this Toxics Use Reduction Plan;
(b) I am satisfied that any supporting documentation used in the development of the Plan exists and is consistent with the Plan;
(c) based on my inquiry of those individuals immediately responsible for the development of this Plan, I believe that the information in the Plan and any supporting documentation used in the development of the Plan is true, accurate, and complete;
(d) the Plan, to the best of my knowledge and belief, meets the requirements of 310 CMR 50.40; and
(e) I am aware that there are penalties for submitting false information, including possible fines and imprisonment.

______________________________________ ____________________

Signature of Senior Management Official Date

____

Print name of Senior Management Official

G. Plan Summary (310 CMR 50.47)

Instead of submitting the complete plan to MassDEP, companies are required to submit a summary of the plan. The plan summary is due on July 1st of the applicable year. It includes:

- the certification statement by the TUR Planner.
- projected facility-wide **changes** in the **total quantities** of each listed toxic chemical used and generated as byproduct between the year on which the plan is based and 2 years, and the year on which the plan is based and 5 years.
- projected byproduct reduction index (BRI) for 2 and 5 years. See Part III, Section E of this document.
- the types of TUR techniques (indicated by number on the TUR matrix from the annual report) to be implemented on each production unit/chemical combination that will result in an increase in the BRI of at least 5 points over a 5 year period.
- any other information the company believes would be beneficial for MASSDEP or the public to review, such as the scope of the plan.

The facility-wide amounts are developed from the projections of reductions in chemical use and byproduct after implementation of TUR options in each production unit. This requirement is found in 310 CMR 50.43~~.~~

Every even reporting year, MassDEP publishes Plan Update Guidance that contains a Plan Summary Form which must be used for the Plan Summary. Please see MassDEP's most recent Plan Update Guidance.

Useful Phone Numbers:

MassDEP -	TURA Program (General Information)	(617) 292-5711
	TUR Planner Certification Information	(617) 574-6820
	TURA Electronic Reporting	(617) 292-5982
OTA -	Industry Specific Assistance, Information and Training	(617) 626-1060
TURI -	Training/TUR Planner Courses/Research	(978) 934-3275

The Following are the MassDEP, TURI and OTA Web Sites:

Toxics Use Reduction Program, Massachusetts MassDEP
http://www.mass.gov/dep/toxics/toxicsus.htm

Toxics Use Reduction Institute (TURI)
http://www.turi.org

Office of Technical Assistance for Toxics Use Reduction (OTA)
http://www.mass.gov/ota

Massachusetts
Department
of
ENVIRONMENTAL
PROTECTION

Commonwealth of Massachusetts
Mitt Romney, Governor

Executive Office of Environmental Affairs
Stephen R. Pritchard, Secretary

Department of Environmental Protection
Robert J. Golledge, Jr., Commissioner